

**Metropolitan Museum of Art**  
**Gas Chromatography- Mass Spectrometry (GC-MS) Results from Material Analysis**

This document includes (1) a mass spectrum and (2) the volatile organic compounds (VOCs) emitted from samples using GC-MS analysis. The data is not interpreted; however, several classes of chemicals are highlighted because they are potential risks for artwork in an enclosed environment. A basic key, provided below, indicates those classes. The amount of each chemical identified has not been determined; similarly, it is not known how much of each chemical is necessary to do damage to art. Finally, peaks may be present that are the result of the sample adsorbing chemicals from the air and reemitting them during testing rather than being inherent to the sample. Research is ongoing to determine specifically which chemicals and amounts are required to negatively affect artifacts.

**Highlighted data:**

Pink – chemicals currently known to be hazardous to art

Green – amines; can raise the pH, are suspected to react with acids and may form crystals in an enclosed environment

Yellow – chemicals of the following type, which *may* be hazardous to art:

*Acids* – lower the pH, corrosive to metals, degrade organic materials

*Aldehydes* – can convert to acids with heat or exposure to UV light

*Esters* – can hydrolyze into acids with heat and humidity

*Sulfur-containing compounds* – known to tarnish and corrode some metals

*Halogenated compounds* – can become reactive with exposure to heat and UV light

*Nitrogen-containing, not amine* – can react with other off-gassed chemicals

*Alkynes* – can become reactive when exposed to heat or UV light

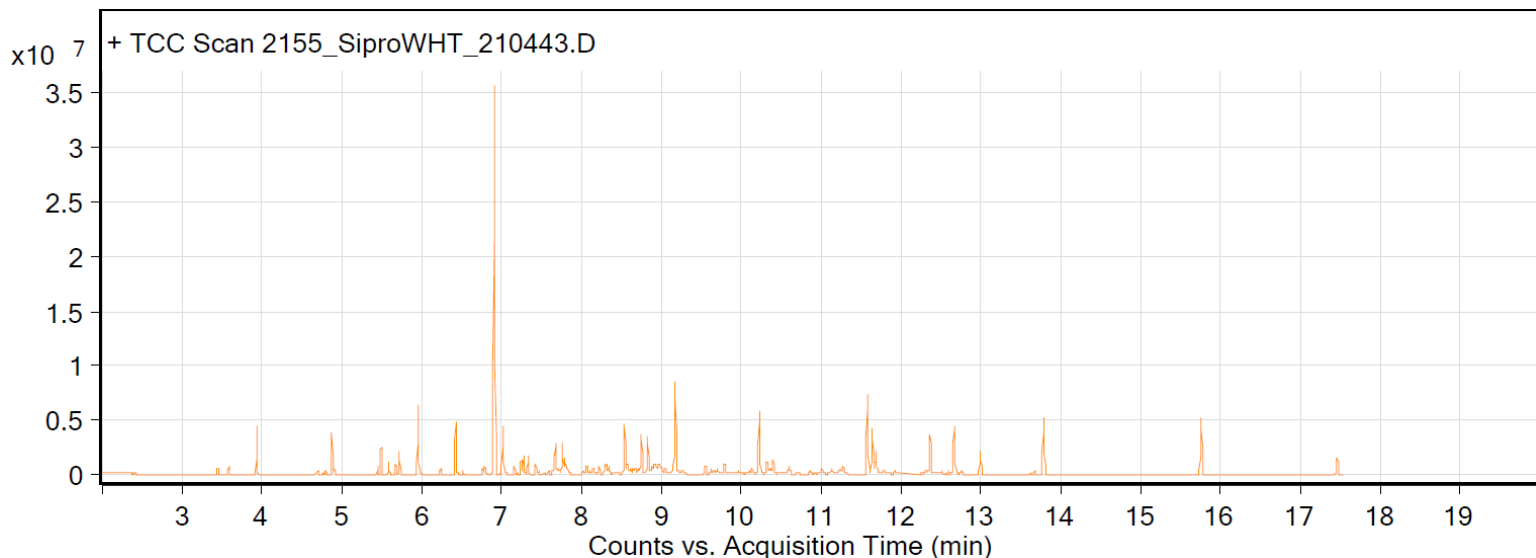
Sample: BSP silikon profile GmBH 7mm white silicone gasket

Oddy test result: temporary

Date collected: 4/30/2018

Technique used: SPME with a PDMS/DVB fiber; Agilent 7890B GC and 5977B MS fitted with a GL Sciences OPTIC-4 multimode inlet and LEAP PAL RTC autosampler; Pre-heated at 60°C for 20 minutes; fiber exposure at 60°C for 20 minutes; sample injected into 220°C inlet and cryo-trapped for 2 min at -15°C; GC ramped from 35°C to 250 °C at 10°C/min. Data analyzed in Masshunter Qualitative Analysis. Deconvoluted data with > 85% match with a NIST 17.0 or Wiley 9 library are reported.

VOCs not highlighted are because they were also observed in blanks: (1) 5.7 min: methoxyphenyl oxime; (2) 12.4 min: 2-methyl-, 2,2-dimethyl-1-(2-hydroxyl-1-methylethyl) propyl ester propanoic acid; (3) 12.7 min: 2-methyl-, 3-hydroxyl-2,4,4-trimethylpentyl ester propanoic acid.



Compound Table

RT	Score (Lib)	Area	Name	Formula
3.45	95.23	443120	2-Propanol	C3H8O
3.58	98.6	605232	Acetic acid	C2H4O2
3.93	93.69	2959678	Silanediol, dimethyl-	C2H8O2Si
4.7	89.73	682421	Propanoic acid, 2,2-dimethyl-	C5H10O2
4.8	96.26	389807	Hexanal	C6H12O
4.88	92.5	3579035	Cyclotrisiloxane, hexamethyl-	C6H18O3Si3
4.91	94.87	545045	Acetic acid, butyl ester	C6H12O2
5.45	93.15	696640	1-Methoxy-2-propyl ester of acetic acid	C6H12O3
5.49	93.07	2528212	Trisiloxane, octamethyl-	C8H24O2Si3
5.58	92.36	1207966	Silane, triethoxymethyl-	C7H18O3Si
5.67	90.63	888501	Butyl isobutyl ether	C8H18O
5.72	85.45	1909922	Oxime-, methoxy-phenyl-	C8H9NO2
5.95	96.91	7003642	Ethanol, 2-butoxy-	C6H14O2
6.23	93.25	517470	1-Ethoxypropan-2-yl acetate	C7H14O3
6.42	96.36	5268644	2-Propanol, 1-butoxy-	C7H16O2
6.51	97.13	454253	Silane, ethenyltriethoxy-	C8H18O3Si
6.76	89.54	570641	Benzene, 1-ethyl-2-methyl-	C9H12
6.8	93.36	782155	Benzaldehyde	C7H6O
6.91	96.64	34187084	Silicic acid (H4SiO4), tetraethyl ester	C8H20O4Si
7.02	92.69	4965011	Propanoic acid, 3-ethoxy-, ethyl ester	C7H14O3
7.16	95.12	835764	Heptane, 2,2,4,6,6-pentamethyl-	C12H26
7.24	95.84	1499286	unidentified C3-benzene	C9H12
7.28	96.85	1898917	Decane	C10H22
7.33	97.83	1780150	Octanal	C8H16O
7.42	88.43	1093319	1-Hydroxyethyl ester of 2-methyl-2-propenoic acid	C6H10O3
7.46	88.29	371874	3-Carene	C10H16
7.59	92.54	406451	Octane, 3,5-dimethyl-	C10H22

7.64	95.68	462941	unidentified C3-benzene	C9H12
7.67	97.35	2205998	1-Hexanol, 2-ethyl-	C8H18O
7.76	97.65	2644388	dl-Limonene	C10H16
8.07	93.57	800241	Dodecane, 2,6,11-trimethyl-	C15H32
8.22	93.26	550208	Dodecane, 2,6,11-trimethyl-	C15H32
8.53	97.07	5045159	2-Butoxyethyl acetate	C8H16O3
8.75	97.02	4817661	Undecane	C11H24
8.83	97.47	4256049	Nonanal	C9H18O
8.92	89.36	1219530	Octane, 2,3,3-trimethyl-	C11H24
8.97	89.02	1713668	Tridecane, 6-methyl-	C14H30
9.14	89.13	987861	Nonane, 4-methyl-5-propyl-	C13H28
9.17	94.84	10601311	Cyclopentasiloxane, decamethyl-	C10H30O5Si5
9.26	88.55	741451	Tetradecane	C14H30
9.62	90.51	561242	Nonane, 5-(1-methylpropyl)-	C13H28
9.7	87.04	724967	Undecane, 3,4-dimethyl-	C13H28
9.96	92.49	546959	Cyclohexanol, 5-methyl-2-(1-methylethyl)-	C10H20O
10.13	93.28	506116	Azulene	C10H8
10.22	95.31	7272950	Dodecane	C12H26
10.32	92.45	1358325	Decanal	C10H20O
10.4	94.42	756058	Undecane, 4,6-dimethyl-	C13H28
11.01	90.26	1157713	Caprolactam	C6H11NO
11.24	91.5	855008	Octane, 2,3,7-trimethyl-	C11H24
11.28	89.51	921070	Undecane, 3,8-dimethyl-	C13H28
11.58	95.47	10276550	Cyclohexasiloxane, dodecamethyl-	C12H36O6Si6
11.64	95.04	5789566	Tridecane	C13H28
11.69	96.63	2717386	2-Ethylhexyl methacrylate	C12H22O2
12.36	90.41	5334435	Propanoic acid, 2-methyl-, 2,2-dimethyl-1-(2-hydroxy-1-methylethyl)propyl ester	C12H24O3
12.67	93.25	6528445	Propanoic acid, 2-methyl-, 3-hydroxy-2,4,4-trimethylpentyl ester	C12H24O3
12.76	93.24	395214	2-Propenoic acid, 1,7,7-trimethylbicyclo[2.2.1]hept-2-yl ester, exo-	C13H20O2
12.99	95.37	2948310	Tetradecane	C14H30
13.67	94.09	450010	Cyclopentane, nonyl-	C14H28